REMARKS

Claims 1-10 were all the claims pending in the application.

Review and reconsideration on the merits are requested.

QUESTION RE DRAWINGS: It is believed that the drawings have been approved, but the Examiner is requested to verify the same. The "X" looks a bit between blocks "A" and "B".

Applicants now turn to the Action on the merits.

Turning first to Election/Restrictions, Applicants affirm their election of claims 1-10.

In DETAILED ACTION, Applicants follow the paragraphing of the Examiner.

Paragraph 2

Claims 1-10 are rejected under 35 U.S.C. § 112, second paragraph, in the use of "produced from". Applicants replaced this term with comprising, one option suggested by the Examiner. The Examiner's interpretation of the claims for purposes of examination is thus correct.

Identification of References:

U.S. Patent 4,454,189 Fukata (Fukata).

U.S. Patent 6,130,292 Harwood et al (Harwood).

U.S. Patent 4,950,529 Ikeda et al (Ikeda).

EP 709499 Auerbach (Auerbach).

EP 353717 Senga (Senga).

Claim Amendments

Claim 1 is amended by including the limits of dependent claim 2. Claim 6 now depends from claim 1.

Claim 2 is amended by including the limits of dependent claim 3 and rewritten as claim 18. Claim 8 depends from claim 18.

Claim 6 is amended by including the limits of dependent claim 7 and further limiting the amount of polyhaloaromatic compound. See the specification at page 8, line 6 for the new range.

In light of the above amendments, claims 2, 3, 4, 5, 7 and 9 are amended. Claim 10, depending from claim 8, is not amended.

The above amendments are for purposes of patentability.

With respect to "branched structure", see page 6, lines 15-18 of the specification.

With respect to "cross-linked structure", see page 9, lines 10-12 of the specification.

With respect to "0.01-0.3 mol %", see page 8, lines 5-7 and note the later discussion regarding the rejection of claims 6-10 over Harwood, Ikeda or Auerbach each in view of Fukata further in view of Senga.

Paragraph 4

Claims 1-5 were rejected under 35 U.S.C. § 102(b) as anticipated by Fukata.

This rejection is respectfully traversed.

The Examiner's position on the prior art is set forth in the Action, and will not be repeated herein except as appropriate.

In the following discussion "polyarylene sulfide" is often abbreviated PAS.

As disclosed in the present specification at page 3, the melt-blown, non-woven fabric of the present invention was obtained or reached based upon the following findings:

"[W]hen substantially linear PAS as described in Japanese Patent Laid-Open No. 1-229855 and non-linear PAS both having the same weight average molecular weight are compared, the substantially linear PAS is more likely be melted unevenly in the die and tends to provide fibers with less uniform diameters, failing to produce non-woven fabrics stably, because the substantially linear PAS clogs the die more often in a long period of time than the non-linear PAS." (underscoring added).

The melt-blown, non-woven fabric is obtained by extruding the branched or cross-linked PAS polymer having a non-Newtonian coefficient of 1.05-1.20 through nozzles at 300-360°C and drawing the polyarylene sulfide extrudate with a hot gas stream at 300-360°C to form extremely fine fibers having an average fiber diameter of 10 μm or less and then depositing the resultant extremely fine fibers on a collector (see page 4, lines 1-9 of the specification). Here, the branched or cross-linked (non-linear) PAS polymers are produced as follows.

(1) Method for introducing branched structure

A mixture of an alkaline metal sulfide and a dihaloaromatic compound can be subjected to a polymerization reaction together with a polyhaloaromatic compound having three or more halogen substituents to introduce a branched structure into PAS. The degree of branching of PAS is controlled by adjusting the amount of the polyhaloaromatic compound added. The amount of the polyhaloaromatic compound is preferably 0.001-0.6 mol %, more preferably 0.01-0.3 mol %, based on 100 mol % of the alkaline metal sulfide (sulfur atoms). The PAS prepared with 0.001-0.6 mol % of the polyhaloaromatic compound has a non-Newtonian coefficient of

1.05-1.20 (see page 8, lines 3-8; and please note the branched repeating unit exemplified by formulae (viii) and (ix) at page 9 of the specification).

(2) Cross-linking method

PAS produced by reaction of an alkaline metal sulfide and a dihaloaromatic compound is cross-linked by a thermal oxidation cross-linking treatment before melt-kneading. The alkaline metal sulfide, the dihaloaromatic compound and the polymerization method therefore may be the same as mentioned above. The thermal oxidation cross-linking treatment is conducted after the polyhaloaromatic compound is added.

The thermal oxidation cross-linking treatment is carried out in an oxygen-containing atmosphere such as the air, a mixed gas of oxygen and an inert gas (argon, carbon dioxide, etc.), etc. In the case of the mixed gas, the oxygen content is preferably 0.5-50 volume % more preferably 10-25 volume %. The thermal oxidation cross-linking is preferably conducted at a temperature of 160-260°C for 1-120 hours. The degree of cross-linking can preferably be controlled by adjusting the thermal oxidation cross-linking time (see page 9, line 10 to page 10 line 15 of the specification).

As opposed to the claims of the present application which call for, *inter alia*, a polyarylene sulfide having a branched structure or having a cross-linked structure, in both instances the polyarylene sulfide exhibiting a non-Newtonian coefficient of 1.05-1.20, Fukata simply discloses a sheet of polyphenylene sulfide formed of a linear polymer, as now explained in more detail.

In distinction, Fukata discloses a sheet of polyphenylene sulfide (PPS) filaments having a fineness of 0.1-15 denier (ca. 1-150 μm) made of a linear polymer having a degree of cross-linking and branching as defined by the non-Newtonian constant n of $0.9 < n < 2.0$ as defined by the formula $\dot{r} = 1/\mu \times T^n$, where $\dot{r}$ is the shear rate, T is the shear force and μ is the viscosity (underscoring added) (see claim 1 of Fukata). Although Fukata mentions a branched PPS polymer in EXAMPLE 4, this polymer is the commercially available "RYTON" PPS made by Phillips Petroleum Co. and Fukata describes neither the measured value of the non-Newtonian constant "n" of this branched PPS nor the method used to obtain a branched or cross-linked PPS polymer. Fukata, in fact, simply discloses a method for preparing a linear PPS polymer of high polymerization degree and discloses that the degree of cross-linking and branching of a polymer can be defined by the non-Newtonian constant n (see column 3, line 61 to column 4, line 10).

Thus, simply stated, Fukata fails to disclose a melt-blown, non-woven fabric having a non-Newtonian coefficient as shown in Examples 1-4 of the present application which is formed of a branched or cross-linked PAS as disclosed in Table 1 of the present application (non-Newtonian coefficient: 1.06-1.19 for Examples 1-4 of the present application) and the corresponding cross-linked or branched PAS of the present application.

Quite clearly the present claims are not anticipated or rendered obvious by Fukata and withdrawal of the rejection over Fukata is requested.

Paragraph 6

Claims 1, 3 and 5 were rejected under 35 U.S.C. § 102(e) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Harwood.

This rejection is respectfully traversed.

Since claim 2 was not rejected over Harwood and Applicants essentially include the limit of claim 2 into claim 1, clearly the rejection over Harwood is avoided. Nonetheless, Applicants offer the following comments in Harwood.

Harwood discloses a method of preparing polyarylene sulfide fibers, particularly PPS fibers, by melt blowing a blend comprising a polyarylene sulfide and a polyolefin, where the polyolefin is present in an amount of 1-40%, by weight of the total blend (see column 3, lines 35-40, column 7, lines 41-47 of Harwood). Suitable PPS resins include cured, semi-cured or linear PPS. The polyarylene sulfide, particularly PPS, is preferably linear (see column 4, lines 6-15 of Harwood). When PPS polymer is used alone, the melt blowing of PPS does not proceed well. The nozzles dribbled after 2 hours in Run No. 1 and leakage of molten polymer due to excess pressure at the dies caused by cross-linked or charred material occurred in Run No. 2 (see Table 3 in columns 11 and 12, column 13, lines 1-5 of Harwood).

Harwood discloses a modification of the fiber or web surface by grafting where graft polymerization is carried out with or without the use of cross-linking agents to graft a hydrophilic or hydrophobic monomer onto the surface of the fibers (see column 10, line 22 to column 11, line 8 of Harwood). However, Harwood is silent as to any thermal oxidation cross-linking treatment before melt-kneading a linear PAS obtained by the reaction of an alkali metal sulfide and a dihaloaromatic compound. Note that a linear PAS-3 is provided in COMPARATIVE EXAMPLE 1 and a linear PAS-4 in COMPARATIVE EXAMPLE 2 in the present application; see page 17 of the specification.

Harwood thus fails to teach a melt-blown, non-woven fabric obtained by extruding a branched or cross-linked PAS polymer alone having a non-Newtonian coefficient of 1.05-1.20.

It is thus quite clear that one of ordinary skill in the art would find no motivation to reach the melt-blown, non-woven fabric of the present invention as defined in amended claims 1 and 18.

Withdrawal of the rejection over Harwood is requested.

Paragraph 7

Claims 1 and 5 were rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Ikeda.

This rejection is respectfully traversed.

Since claim 2 was not rejected over Ikeda, and Applicants have essentially included the limits of claim 2 into claim 1, clearly the rejection over Ikeda is avoided. Nonetheless, Applicants offer brief comments on Ikeda.

Ikeda discloses a fabric comprising of an extra fine fiber having a mean diameter of 0.1-8.0 μm obtained by melt-blowing a linear polymer of polyphenylene sulfide (see claim 1 and column 3, lines 48-55, column 5, lines 24 of Ikeda). Ikeda thus fails to teach a melt-blown, non-woven fabric obtained by extruding a branched or cross-linked PAS polymer alone having a non-Newtonian coefficient of 1.05-1.20. Ikeda clearly calls for "an extra fine fiber obtained by melt-blowing a linear polymer of polyphenylene sulfide" in claim 1.

Since the non-Newtonian coefficient of a linear PPS polymer is 1, the PPS polymer disclosed in Ikeda must fall outside the scope of the present claims where the polyarylene sulfide has a non-Newtonian coefficient of 1.05-1.20.

Considering the above, quite clearly one of ordinary skill in the art who would refer to Ikeda would have no motivation to reach the melt-blown, non-woven fabric of the present invention as recited in claims 1 and 18 herein.

Withdrawal of the rejection over Ikeda is requested.

Paragraph 8

Claims 1 and 5 were rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Auerbach.

This rejection is respectfully traversed.

Since claim 2 was not rejected over Auerbach, and Applicants have essentially included the limits of claim 2 into claim 1, quite clearly the rejection over Auerbach is avoided. However, Applicants offer brief comments on Auerbach.

Auerbach discloses melt-blown microfiber webs with diameters of 0.1-20 μm, which have been prepared from a mixture comprising a polyarylene sulfide polymer and an organic phosphite or phosphonite (see page 4, lines 3-7 of Auerbach). The polyarylene sulfide polymer

includes not only homopolymers of arylene sulfide units but also copolymers including sulfide units.

With respect to the PAS polymer, Auerbach merely discloses that "The polyarylene sulfide may be cross-linked. It is preferably linear (see page 4, lines 40-44 of Auerbach)." In this regard, Auerbach fails to disclose the method used to produce the branched or cross-linked PAS polymer as disclosed in the present application. The PAS used in the present invention has a non-Newtonian coefficient of 1.05-1.20. Since PAS approaches a linear polymer as the non-Newtonian coefficient (N) approaches 1, and the larger the non-Newtonian coefficient (N), the higher the percentage of branched or cross-linked structure in the PAS (see page 6, lines 8-11 of the specification), quite clearly the disclosure in Auerbach does not suggest the subject matter of claim 1/2 as now presented.

Withdrawal of the rejection over Auerbach is requested.

Paragraph 9

Claims 1-5 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Harwood, Ikeda or Auerbach each in view of Fukata.

These references have been individually discussed above.

The rejection of these claims is respectfully traversed.

As earlier discussed with respect to Fukata, although Fukata discloses a sheet of polyphenylene sulfide (PPS) filaments each having a fineness of 0.1-15 denier, Fukata does not actually disclose the non-Newtonian constant n of the PPS filaments used made of the cross-linked or branched PPS polymer. Since Fukata is quite in precise regarding the degree of cross-

looking and branching of the polymers used in Fukata which in theory would fall within the range of 0.9-2.0 as defined in Fukata, it is thus quite reasonable to conclude that in Fukata the non-Newtonian constant "n" is not the subject of complete disclosure.

Therefore, since each of Harwood, Ikeda and Auerbach fails to teach a melt-blown, non-woven fabric obtained by extruding a branched or cross-linked PAS polymer having a non-Newtonian coefficient of 1.05-1.20, one of ordinary skill in the art, that would refer to Harwood, Ikeda or Auerbach even in view of Fukata would not be motivated to reach the present invention as claimed in claims 1 and 18.

Withdrawal is requested.

Paragraph 10

Claims 6-10 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Harwood, Ikeda or Auerbach each in view of Fukata, further in view of Senga.

This rejection is respectfully traversed.

Harwood, Ikeda, Auerbach and Fukata and the combination thereof have been discussed above. Applicants here focus on Senga to support their traversal.

Senga discloses PAS prepared by contacting at least one metallic sulfide (A) selected from an alkali metal sulfide and an alkali metal hydrosulfide with a dihalogen aromatic compound (B) and an aromatic compound (C) having three or more than three functional groups, wherein the molar ratio of the dihalogen aromatic compound (B) to the metal sulfide (A), [(B)/(A)] is within the range from 1.035/1 to 1.300/1, and the molar ratio of the aromatic compound (C) to the dihalogen aromatic compound (B), [(C)/(B)], is within the range from

0.003/1 to 0.05/1 (see page 4, lines 43-49 of Senga). In view of the disclosure relating to degree of branching parameter (Bl) in Senga, it is clear that the degree of cross-linking of the Senga PAS polymer is low, i.e., the non-Newtonian behavior is very low or small (see page 3, line 58 to page 4, line 20 of Senga).

With respect to processes of making PAS polymers, Senga does teach elements of preparing the PAS polymers of the present application.

However, Senga's process conditions are directed to preparing a linear PAS polymer, whereas the present application is directed to obtaining a branched or cross-linked (non-linear) PAS polymer, where the process conditions differ from Senga in the corresponding molar ratio of the polyhaloaromatic compound to the dihalogen aromatic compound.

As disclosed in the present specification at page 8, the degree of branching of PAS can be controlled by adjusting the amount of the polyhaloaromatic compound added. The amount of the polyhaloaromatic compound is preferably 0.001-0.6 mol % more preferably 0.01-0.3 mol % based on 100 mol % of the alkaline metal sulfide (sulfur atoms). PAS prepared with 0.001-0.6 mol % of the polyhaloaromatic compound has a non-Newtonian coefficient of 1.05-1.20. Since in the present application the molar ratio of the dihalogen aromatic compound (b) to the metal sulfide (a) is nearly equal to 1, the molar ratio of the polyhaloaromatic compound (c) to the dihalogen aromatic compound (b) is preferably 0.0000l/1-0.006/1, more preferably 0.0001/1-0.003/1.

Specifically, [(c)/(a)] and [(c)/(b)] in SYNTHESIS EXAMPLES 1 and 2 of the present application are as follows:

SYNTHESIS EXAMPLE 1: (a) Na_2S 15.4 kg (120.0 mol)

(b) p-dichlorobenzene 17.70 kg (120.4 mol)

[(b)/(a)] 120.4/120.0 1.003/1

(c) 1,3,5-trichlorobenzene 32.42 g (0.179 mol)

[(c)/(a)] 0.179/120.0 = 0.0015/1

[(c)/(b)] 0.179/120.4 = 0.0015/1

SYNTHESIS EXAMPLE 2: (a) Na_2S 15.4 kg (120.0 mol)

(b) p-dichlorobenzene 17.52 kg (119.2 mol)

[(b)/(a)] = 119.2/120.0 = 0.993/1

(c) 1,3,5-trichlorobenzene 16.21 g (0.089 mol)

[(c)/(a)] = 0.089/120.0 = 0.0007/1

[(c)/(b)] = 0.089/119.2 = 0.0007/1

Thus, it is quite clear that the molar ratio of the aromatic compound (C) to the dihalogen aromatic compound (B), [(C)/(B)] of Senga, falls outside the range of the corresponding molar ratio [(c)/(b)] ranging from 0.0001/1 to 0.003/1 in the present application.

With respect to process of making the branched or cross-linked PAS polymer, Senga is silent regarding any method for introducing a branched structure into PAS and is silent regarding any cross-linking method. Accordingly Senga fails to teach the branched or cross-linked PAS polymer having a non-Newtonian coefficient of 1.05-1.20 of the present invention.

As earlier discussed with respect to the combination of Fukata, Harwood, Ikeda and Auerbach, this combination of references does not affect the novelty and unobviousness of the present invention as reflected in claims 1 and 18. Since Senga fails to teach the branched or cross-linked PAS polymer having a non-Newtonian coefficient of 1.05-1.20 of the present invention, even if one of ordinary skill in the art would combine Fukata and Senga with each of Harwood, Ikeda and Auerbach, one would not reach the invention as defined in claims 6 and 8 of the present application.

Withdrawal is requested.

Allowance is requested.

Respectfully submitted,

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APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Claims 2, 3, 4, 5, 7 and 9 are canceled.

The claims are amended as follows:

1. (Amended) A melt-blown, non-woven fabric [produced from] comprising polyarylene sulfide having a branched structure and a non-Newtonian coefficient of 1.05-1.20.

6. (Amended) The melt-down, non-woven fabric according to claim [2] 1, wherein said polyarylene sulfide is a reaction product of an alkaline metal sulfide, a dihaloaromatic compound and a polyhaloaromatic compound having 3 or more halogen substituents in one molecule, wherein 0.01-0.3 mol %, based on 100 mol % of said alkaline metal sulfide, of said polyhaloromatic compound is added in a reaction to form the reaction product.

8. (Amended) The melt-down, non-woven fabric according to claim [3] 18, wherein said polyarylene sulfide is subjected to a thermal oxidation cross-linking treatment.

Claim 18 is added as a new claim.